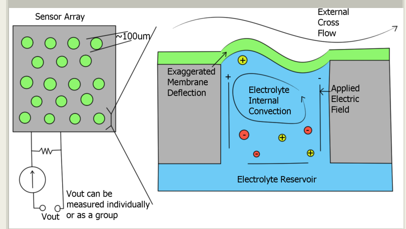
Small Business Innovation Research/Small Business Tech Transfer

Measuring Shear Stress with a Microfluidic Sensor to improve Aerodynamic Efficiency, Phase I

Completed Technology Project (2014 - 2014)

Project Introduction

Skin friction drag is directly proportional to the local shear stress of a surface and can be the largest factor in an aerodynamic body's total parasitic drag. The measurements of the local shear stress has long been a difficult measurement in an air-flow environment due to the interaction between the sensor and air flow. In order for modern researchers to further improve the efficiency of aircraft and other aerodynamic bodes, sensitive measurements in the smallest scale possible are required. To achieve this goal, the measurement community has turned towards micro-electrical mechanical systems which utilize microscopic moving parts to directly measure the shear stress. Unfortunately the cost, sensitivity, and packaging have proven to be insurmountable challenges in sensor development. Our company proposes a paradigm shift in shear stress measurements that will take advantage of the complete sensing package offered in MEMS without the need for moving mechanical parts or expensive manufacturing. Our patent pending sensor will allow us to measure the shear stress at a wall using microfluidic principles and fluid-structure interactions. In our proposed sensor, highly sensitive electrochemical measurements measure the vibrations induced in a membrane by the external shear stress. Because of the nature of electrochemical measurements, the relationship between size and sensitivity is reversed compared to MEMS sensing methods. As our sensor decreases in size, the current change induced in the system increases, resulting in a sensitivity limit imposed only by manufacturing limits. We believe that this sensor will have the ability to obtain real-time shear stress measurements across the range of external air flows. Due to the absence of moving parts within our proposed system, we believe that the sensor will be significantly more robust and durable for many different applications. At the conclusion of this project, we expect to move this technology from TRL-2 to TRL-4.



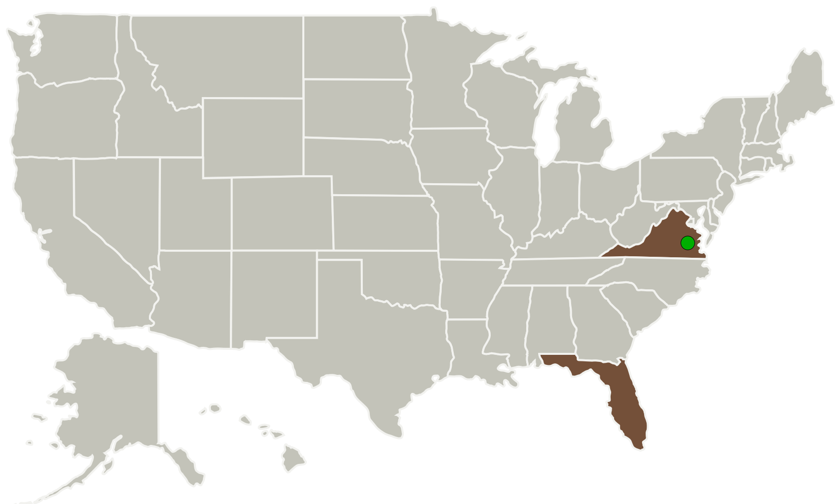
Measuring Shear Stress with a Microfluidic Sensor to improve Aerodynamic Efficiency Project Image

Table of Contents

Measuring Shear Stress with a Microfluidic Sensor to improve Aerodynamic Efficiency, Phase I

Completed Technology Project (2014 - 2014)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
American Nanofluidics	Lead Organization	Industry	Altamonte Springs, Florida
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Florida	Virginia

Project Transitions

June 2014: Project Start

December 2014: Closed out

Closeout Documentation:
- Final Summary Chart*(https://techport.nasa.gov/file/137599)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

American Nanofluidics

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

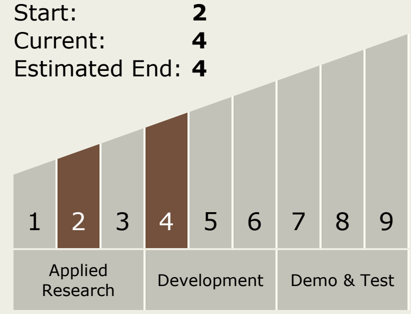
Carlos Torrez

Principal Investigator:

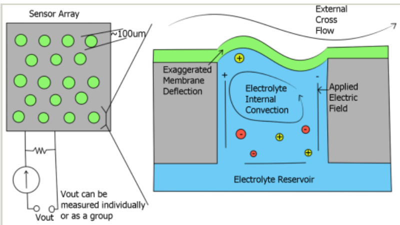
Christopher N Hughes

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



Images



Project Image
Measuring Shear Stress with a Microfluidic Sensor to improve Aerodynamic Efficiency Project Image
(https://techport.nasa.gov/image/137005)

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  └ TX15.1 Aerosciences
    └ TX15.1.1 Aerodynamics

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System